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Running head: MEASURING HUNGER AND SATIETY IN CHILDREN

Measuring Hunger and Satiety in Primary School Children: Validation of a New Picture Rating Scale

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Abstract

Measuring hunger and satiety in children is essential to many studies of childhood eating behaviour and obesity. Despite this, few validated measures currently exist that allow children to make accurate and reliable ratings of their hunger/satiety. Three studies aimed to address this issue by validating the use of a new categorical rating scale, Teddy the Bear, in the context of estimated and real eating episodes. Forty-seven 6-8 year old primary school pupils participated in Study 1, which used a between-participant design. Results from this study indicated that the majority of children were able to use the scale to make estimated hunger/satiety ratings for a character in a story using the scale. No significant differences in the ratings of hunger/satiety of children measured before and after lunch were observed and likely causes are discussed. To account for inter-individual differences in hunger/satiety perceptions Study 2 employed a within-participant design. Fifty-four 5-7 year olds participated in this study and made estimated hunger/satiety ratings for a story character and real hunger/satiety ratings before and after lunch. The results from this study indicated that the majority of children were able to use the scale to make estimated and real hunger and satiety ratings. Children were also found to be significantly hungrier before compared to after lunch. As it was not possible to establish what types of food and in what quantity children ate for lunch a third study was carried out in a controlled laboratory environment. Thirty-six 6-9 year olds participated in Study 3 and made hunger/satiety ratings before and after ingesting an ad libitum snack of known composition and quantity. Results indicate that children felt hungrier before than after the snack and that pre-snack hunger/satiety, as well as changes in hunger/satiety, were associated with ad libitum snack intake. Overall, the studies indicate that our new categorical rating scale has potential for use with primary school children. Implications of our findings and possible contexts for its application are discussed.

Keywords: Hunger, Satiety, Rating Scale

Measuring Hunger and Satiety in Primary School Children: Validation of a New Picture Rating Scale

Being able to accurately assess hunger and satiety in children is essential to many studies in the field of childhood eating behaviour. Studies measuring snack intake with the Eating in the Absence of Hunger paradigm rely on children's self-reported hunger and satiety. Other studies rely on children being in a fasted or non-fasted state to later establish factors like children's abilities to compensate for different caloric preloads. Despite this, few validated measures exist that are known to accurately reflect children's own perceptions of their hunger and satiety.

Some studies into childhood eating behaviour have relied on visual analogue scales commonly applied in research with adults and adolescents to establish hunger and satiety in children aged 8-12. Roemmich, Wright, and Epstein (2002) asked children to rate their hunger/satiety using a 100mm visual analogue scale with the anchors "very hungry/very full". Nevertheless, the paper did not present any indication of children's comprehension of this scale or of changes in hunger/satiety ratings prior to and after snack intake. Developmental research suggest that children need to be able to seriate their perceptions of hunger and satiety from hungry to full correctly before being able to use a visual analogue scale correctly and reliably (Shields, Palermo, Powers, Grewe, & Smith, 2003). Keller et al. (2006) found that the majority of children in their sample aged 4-5 years were able to use an age-appropriate visual analogue scale to reflect changes in estimated fullness, after having received a considerable amount of training. This suggests that abilities to seriate may be present from an earlier age, but that tasks relying on the application of seriation techniques may be dependent on training. It is therefore likely that ratings of hunger and satiety on an abstract visual analogue scale demand greater cognitive abilities than those commonly present in untrained children aged 7 years or younger (Shields, Palermo et al., 2003). Research by Shields et al. indicated that child age and IQ, used as an indicator of cognitive ability, were the best predictors of kindergarteners' abilities to correctly make ratings using a visual analogue scale. As more than 50% of children aged 5-7 years who participated in their study failed to use the visual analogue scale

correctly, the authors suggest that alternative rating scales should be used when working with children aged 7 years or younger. In a further study carried out by Shields, Cohen, Harbeck-Weber, Powers, and Smith (2003) the ability of children aged 5-14 years to correctly mark a VAS and understand the concept of a VAS for pain experiences was tested. Shields, Cohen et al. (2003) report that only one third of the 106 children who participated in their study were able to correctly use and understand the VAS, with age being the best predictor of performance. Importantly, there were no differences in children's abilities to use and understand the VAS based on whether they received a basic or a more intensive amount of training to use it. Pilot work with three 7-8-year olds in our own lab indicated that even children of this older age-range children found abstract visual analogue scales difficult to use and that their ratings did not correspond with verbal explanations of their current hunger/satiety perceptions.

Previously developed hunger and satiety rating scales for use with children have generally consisted of figures with manipulated stomach regions as children have been found to reliably associate this body region with feelings of hunger and satiety (Faith, Kermanshah, & Kissileff, 2002). Fisher and Birch (1999) used cartoon figures with varying amounts of food in their stomachs to assess 3-6 year-old children's reported hunger and satiety in the context of an EAH paradigm. The authors only included the data of those children who reported being full after a meal and who had access to snacks afterwards, in their analyses. It remains unclear though how many children were excluded due to a failure to understand the scale.

Research by Faith et al. (2002) and Keller et al. (2006) has also focused on the development of measures assessing estimated hunger and satiety. Faith et al. (2002) developed a range of silhouettes to assess satiety in children aged 4-6 years. Silhouettes were gender specific and contained various amounts of food in the stomach regions, allowing children to make judgements of estimated fullness. Based on the research by Faith et al., Keller et al. (2006) developed an analogue scale (Freddy), which consisted of a cardboard cut-out doll, with an adjustable stomach, allowing children to dynamically regulate estimated hunger and satiety. This scale has shown good

applicability to estimated hunger and satiety states in children aged 4-5 years and has also been used in the context of real eating episodes. Kissileff, Keller, Lofink, Torres, and Thornton (2008) evaluated the ability of 5-6 year-olds to use the scale to reflect increases in satiety in response to 15 individual 15ml portions of a yoghurt shake and found that after two training/testing sessions the majority of the 11 children who participated in their study were able to indicate greater fullness in response to intake.

To address the lack of hunger/satiety rating scales that can be used in the context of estimated as well as real eating episodes, we developed a new picture rating scale, "Teddy the Bear", consisting of five pictures of Teddies which had varying amounts of food in their stomachs and which were accompanied by descriptive vignettes. The purpose of the scale was to allow children to make accurate ratings of their current feelings of hunger/satiety. Our studies therefore aimed to establish whether the Teddy scale could be used to measure hunger/satiety in primary school children aged 5-9 years. We assessed children's comprehension of the scale while examining possible effects of age and gender (Study 1) and also assessed the scale's ability to reflect changes in estimated hunger/satiety states (Study 1) and with respect to a real eating episode (Study 2). Additionally we established whether the scale was able to reflect changes in hunger/satiety in the context of the ingestion of an ad libitum snack in a controlled environment (Study 3).

Study 1

Method

Participants

Forty-seven children aged 6 years to 8 years participated in this study. The sample consisted of 27 females and 20 males, who were predominantly White British. Children were typically developing and attended years three and four of a primary school in Birmingham, UK. The index of multiple deprivation (2010) for the school and the surrounding areas indicated that the sample of children

participating in this study is likely to be drawn from the most deprived 50% of English communities (Index of Multiple Deprivation, 2012).

Measure

For the purpose of this study a picture rating scale, aimed at assessing hunger and satiety was developed. The scale consisted of five black and white cartoon bear silhouettes. Varying amounts of “food” were represented by black ovals in each bears’ stomach area, which increased in size proportionally as the amount of food consumed and the satiety of the bear increased. Each of the five bear silhouettes was accompanied by a label placed above the silhouette, which described the bear’s level of hunger and satiety, starting from 1 (*very hungry*) to 5 (*not hungry at all/very full*) (see Figure 1).

Figure 1 about here

Procedure

The study was conducted over one school day starting at 09:00 and ending at 15:10. Children were tested at school on a one-to-one basis, within a quiet corner of the classroom. Children were asked if they would like to do some work with the researcher and, if they agreed, children were told the story about Teddy the Bear (story outline below). The story had an interactive element; children were asked to rate Teddy’s hunger at two points during the story, while also rating their own currently perceived hunger/satiety state. Each child’s participation lasted for no more than 10 minutes. The researcher recorded whether children took part in the study in the morning after breakfast but before a mid-morning snack, in the morning after a mid-morning snack and before lunch or in the afternoon after lunch. Children were given a sticker as a thank you for taking part and returned to their seats following their participation. This study was approved by the Ethical Review Committee of the University of Birmingham.

Story. The scale's appropriateness to accurately reflect estimated states of hunger/satiety was evaluated through a fictional story, which revolved around "Teddy the Bear". In the story Teddy went to the park, and after spending the whole day there playing he realised that he was very hungry and consequently returned home to prepare and eat a large meal after which he felt very full. (For the full story please see Appendix A)

Stage 1. Familiarisation with the scale. Initially the researcher introduced the child to the scale by looking at the pictures of Teddy and reading the labels accompanying each picture of Teddy with the child. The child was made aware of the differences between each picture and label and the researcher checked child comprehension by asking the child to tell the researcher how hungry and how full s/he thought the different Teddy bears were.

Stage 2. Application of scale to estimated hunger and real hunger. The researcher read the story to the child and asked the child to show how hungry s/he thought Teddy was at two time points during the story once prior to a large meal and once after consuming it, by using the scale. Children were also asked to rate how hungry they felt themselves currently by using the scale (see Appendix B for script).

Statistical Analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05. Bar graphs were inspected and indicated that the majority of data were not normally distributed; only children's ratings of their own hunger were normally distributed. Nonparametric tests were therefore conducted on all variables except for children's ratings of their own hunger. Initially, children's ratings of hunger/satiety were examined. Spearman's correlations were carried out to examine whether child age was significantly related to children's ratings of hunger/satiety. Additionally, Mann-Whitney U tests were carried out to see if there were differences in children's ratings of Teddy's hunger/satiety based on child gender, while an independent samples t-test was used to establish differences in children's own hunger ratings based on gender. Finally, a Wilcoxon Signed Rank test was used to assess whether children's ratings of Teddy's hunger differed before

and after Teddy had a meal, while an independent samples t-test was used to assess whether there were any differences in hunger/satiety levels in children tested before or after lunch.

Results

Children's ratings of hunger/satiety

Children's ratings of Teddy's hunger/satiety prior to a meal ranged from "Really hungry" (1) to "Not too hungry and not too full" (3) (Median [*Mdn*] hunger rating=1, Interquartile Range [*IQR*]=0). Children's ratings of Teddy's hunger/satiety after a meal ranged from "Really hungry" (1) to "Really full" (5) (*Mdn* hunger rating=5, *IQR*=0). 89.4% (*n*=42) of children correctly rated Teddy as hungry prior to a meal by selecting "Really hungry" (1) or "Slightly hungry" (2) on the picture rating scale in accordance with the story. Furthermore, 91.5% of children (*n*=43) correctly rated Teddy as full after a meal by selecting "Quite full" (4) or "Really full" (5). The data of children who were unable to correctly rate Teddy's hunger/satiety before and after a meal (*n*=1) were excluded from all further analyses. Children's ratings of their own hunger/satiety at the time of testing ranged from "slightly hungry" (2) to "not too hungry and not too full" (3).

The impact of age and gender on hunger/satiety ratings

Spearman's correlation analyses were carried out to examine whether child age was related to children's hunger/satiety ratings. Analyses indicated that age did not significantly correlate with children's ratings of Teddy's hunger/satiety before a meal, $r_s(44)=.0$, $p=0.999$ and after a meal, $r_s(44)=-.137$, $p=.364$. Child age was also not related to children's ratings of their own hunger/satiety levels $r_s(44)=.067$, $p=.659$.

Mann-Whitney U tests were carried out to examine the effect of gender on hunger/satiety ratings. The tests indicated that females consistently rated Teddy to be hungrier before a meal than males. No other differences in children's ratings of hunger/satiety based on gender were found (see Table 1).

Table 1 about here

Differences in pre-and post-meal hunger/satiety ratings for Teddy and children's own hunger

A Wilcoxon Signed Rank test was carried out to examine whether there was a significant difference in children's ratings of Teddy's hunger/satiety before and after Teddy had a meal. In support of our hypotheses the test revealed that children rated Teddy to be significantly more hungry prior to a meal ($Mdn=1$, $IQR=0$) than after a meal ($Mdn=5$, $IQR=0$), ($Z=6.042$, $p<.001$). Additionally, an independent samples t -test was carried out to assess whether children's ratings of their own hunger differed before and after having had lunch. Contrary to our hypotheses children's hunger ratings made before lunch ($M=2.47$, $SD=1.23$) did not differ from their ratings made after lunch ($M=2.45$, $SD=1.3$), ($t(44)=-.057$, $p=.955$).

Discussion

The results of Study 1 indicate that children are able to use the new picture rating scale to estimate hunger/satiety in Teddy following the descriptions of a hunger and satiety state in a story. In fact around 90% of children correctly estimated hunger and satiety in Teddy, suggesting that the majority of children aged 6-8 years are able to understand and use this scale appropriately. It is unclear however, whether children are able to use the scale as effectively when reporting their own hunger/satiety. Children's hunger/satiety levels did not differ whether they were tested before or after lunch. These results are perhaps unsurprising, as it was not possible to determine the time at which children had consumed breakfast, if they consumed it at all, and what their breakfast consisted of. This meant that there were large variations in children's hunger/satiety ratings in the morning. Additionally, some children consumed a mid-morning snack at 10.30 am, which is likely to have diminished hunger ratings of those children tested after a snack but before lunch. Furthermore,

we expected large inter-individual differences in children's hunger and satiety ratings throughout the day based on the between-subjects design of this study.

Therefore, to address this study's inability to clarify whether the Teddy scale can be successfully used to measure change in children's hunger/satiety in the context of a real eating episode, Study 2 employed a within-subjects design. Some research suggests that girls are more sensitive to researcher demands (Hoffman, 1972). We therefore carried out gender specific analyses of child ratings to establish whether boys and girls differed systematically in their ratings of Teddy's hunger/satiety and of their own hunger. The results of Study 1 indicated that there was only one gender difference in children's hunger/satiety ratings; females were found to rate Teddy as hungrier prior to a meal than males. As this gender difference was only observed for one of the three ratings it is likely to be due to chance and not to a pervasive gender difference. A further study into gender differences in children's hunger/satiety ratings of Teddy may help to clarify the meaning and importance of this finding. Age was not related to any of the children's hunger ratings, suggesting that age was not systematically related to the children's use of the scale, and that the scale is appropriate for research focusing on estimated hunger/satiety ratings with children aged 6-8 years.

Study 2

The results from Study 1 indicated that children were able to use the scale to rate hunger/satiety. Study 1 also suggested that the scale is able to detect changes in estimated/imagined hunger/satiety in response to the story about Teddy the Bear. Nevertheless, it is unclear whether the scale is able to reflect changes in real hunger/satiety. To test this, Study 2 aimed to further assess the use of the picture rating scale to measure hunger/satiety in primary school children aged 5 to 7 years. To address the impact of inter-individual differences in hunger ratings on the scale's ability to reflect variations in hunger, a within-participant design was used to assess differences in children's hunger ratings before and after lunch. We also trialled a group methodology in study 2, to establish whether

the scale can be administered effectively to classroom groups rather than requiring one-to-one interaction.

Method

Participants

Fifty-four children aged 5 years to 7 years participated in this study. The sample consisted of 25 females and 29 males, which were predominantly White British. Children were typically developing and attended years three and four of a primary school in Birmingham, UK. The index of multiple deprivation (2010) for the school and the surrounding areas indicated that the sample of children participating in this study is likely to be drawn from the most deprived 50% of English communities (Index of Multiple Deprivation, 2012).

Measures

The previously described Teddy picture rating scale was used (see Method section Study 1, Figure 1). Additionally children were asked to provide their age and gender on the provided form.

Procedure

The study was conducted over one school day with two groups of children making hunger and satiety ratings before and after their lunch break at 11.40 and 13.05, respectively. Each one of the two participating classrooms was addressed as a whole and both classrooms were tested in succession over a 15 minute period before lunch and after lunch. Children were seated at their desks, given sheets including questions about their age and gender and including the Teddy rating scale. The Teddy rating scale was repeated on two separate pages so that children could not see the hunger/satiety ratings they made before lunch when they made their hunger/satiety ratings after lunch. Children were told to work on their sheets individually at both time-points. Before lunch, the researcher initially introduced the children to the scale by looking at the pictures and reading the labels accompanying each picture with the children. The children were made aware of the differences between each picture and label. The researcher then read the story about Teddy

(described in study 1) and children were asked to make two hunger/satiety ratings for Teddy by circling the bear, which most closely resembled the hunger/satiety states described in the story. This was done to assess children's comprehension of the scale and their ability to correctly use the scale to indicate estimated hunger/satiety. Finally, children were asked to rate their own current hunger/satiety state. After lunch children made one further rating of their own current hunger/satiety state using the scale (see Appendix B for script). The classroom teachers and teaching assistants aided the researcher by ensuring that children attended to the researcher and by addressing questions children had. This study was approved by the Ethical Review Committee of the University of Birmingham.

Statistical analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05. Bar graphs were inspected and indicated that the data was not normally distributed. Initially, children's ratings of hunger/satiety were examined. Spearman's correlations were carried out to examine whether child age was significantly related to children's ratings of hunger/satiety; additionally, Mann-Whitney U tests were carried out to assess the effect of gender on children's ratings. Wilcoxon Signed Rank tests were carried out to see whether children's ratings of Teddy's hunger before and after a meal and whether children's ratings of their own hunger before and after lunch differed.

Results

Children's ratings of hunger/satiety

Children's ratings of Teddy's hunger/satiety before a meal ranged from "Really hungry" (1) to "Really full" (5) (*Mdn* hunger rating=1, *IQR*=0.5), while after a large meal their ratings of Teddy's hunger/satiety ranged from "Really hungry" (1) to "Really full" (5) (*Mdn* hunger ratings=5, *IQR*=1). 87% of children (*n*=47) correctly rated Teddy as hungry prior to the meal, by selecting "Really hungry" (1) or "Slightly hungry" (2) on the picture rating scale, while 90.8% of children (*n*=49)

correctly rated him as full after the meal, by selecting “Quite full” (4) or “Really full” (5) on the picture rating scale. The data of children who were unable to correctly rate Teddy’s hunger/satiety before and after a meal ($n=3$) were excluded from all further analyses. Children’s abilities to successfully rate hunger/satiety for Teddy did not depend on their age ($U=108$, $z=1.303$, $p=.255$) or gender ($\chi^2(1, N=54)=.53$, $p=.467$).

Children’s ratings of their own hunger/satiety before lunch ranged from “Really hungry” (1) to “Really full” (5) (Mdn hunger rating=1, $IQR=2$), while their hunger/satiety ratings ranged from “Really hungry” (1) to “Really full” (5) (Mdn hunger rating=4, $IQR=2$) after lunch. We calculated hunger/satiety change by subtracting post-meal hunger ratings from pre-meal hunger ratings. Hunger change scores ranged from -3 to +4, with the average hunger change score being $Mdn=2$ ($IQR=4$), indicating that on average children’s ratings of their own hunger moved up two pictures on the Teddy rating scale, reflecting a decrease in hunger following lunch.

Effects of age and gender on children’s ratings

Spearman’s correlation analyses were carried out to examine whether child age significantly correlated with children’s ratings of hunger/satiety. Analyses indicated that age did not significantly correlate with children’s ratings of Teddy’s hunger/satiety before a meal, $r_s(49)=-.049$, $p=.735$, while it did correlate with children’s ratings of Teddy’s hunger/satiety after a meal, $r_s(49)=-.306$, $p=.029$. Child age was not related to children’s ratings of their own hunger/satiety before lunch $r_s(49)=-.068$, $p=.638$ or after lunch $r_s(49)=-.068$, $p=.635$.

Mann-Whitney U tests were carried out to examine the effect of gender on hunger/satiety ratings. The tests indicated that there were no significant differences in children’s ratings of Teddy’s hunger/satiety prior to and after consuming a meal based on gender. Additionally, child gender did not affect children’s ratings of their own hunger/satiety before or after lunch (see Table 2).

Table 2 about here

309

310 *Differences in hunger ratings before and after Teddy's meal and the children's lunch*

311 A Wilcoxon Signed Rank test was carried out to examine whether there was a significant
 312 difference in children's ratings of Teddy's hunger/satiety before and after Teddy had a meal. The
 313 data for all children, including those who were unable to make accurate ratings of Teddy's hunger
 314 before/after a meal were included in this analysis only. The test indicated that children rated Teddy
 315 to be significantly more hungry prior to a meal ($Mdn=1$, $IQR=0.5$) than after a meal ($Mdn=5$, $IQR=1$),
 316 ($Z=6.089$, $p<.001$). Finally, a Wilcoxon Signed Rank test was carried out to examine whether there
 317 was a significant difference in children's ratings of their own hunger/satiety before and after lunch.
 318 In line with our hypotheses, children rated themselves as significantly hungrier before lunch ($Mdn=1$,
 319 $IQR=2$) compared to after lunch ($Mdn=4$, $IQR=2$), ($Z=4.729$, $p<.001$).

320

321 Discussion

322 The results of Study 2 supported the results of Study 1; children were able to use the scale to
 323 make judgements about estimated hunger/satiety in Teddy following a story describing a state of
 324 hunger and satiety. Around 89% of children correctly rated Teddy as hungry or full when these states
 325 were described in the story. Furthermore, gender did not significantly impact on children's ratings of
 326 their own hunger/satiety or estimated hunger/satiety for Teddy. Nevertheless, child age was related
 327 to children's ratings of Teddy's hunger in this study, as younger children rated Teddy to be fuller
 328 after a meal. These findings may reflect differences in food quantity perception related to age. In the
 329 story children heard Teddy consumes a large amount of food; younger children may have perceived
 330 the amount of food ingested by Teddy to be larger than older children. This had not been observed
 331 in the previous study, and as only one of the ratings children had to make was related to child age,
 332 this result may be due to chance, although slightly younger children were included in this sample.

333 Importantly, the results indicate that the scale is able to reflect changes in hunger/satiety in the
 334 context of a real eating episode. Children rated themselves as significantly hungrier before lunch

compared to after lunch. This suggests that the non-significant findings of Study 1 were likely due to inter-individual differences in children's hunger/satiety ratings as well as to the uncertainty regarding children's consumption of breakfasts and mid-morning snacks. The within-participant design of Study 2 therefore overcomes this particular limitation of Study 1. In Study 2 all children consumed a mid-morning snack at the same time and had an equal amount of time until lunch.

All children were tested as a group, at the same time, avoiding any hunger/satiety rating variations due to differences in the time since their last meal. The differences in children's hunger/satiety ratings before and after lunch are therefore likely to be an accurate reflection of the changes in their hunger/satiety perceptions due to the ingestion of their pre-packed lunch foods. Unfortunately, we were unable to establish what each child's lunch consisted of, but pre-post lunch hunger/satiety ratings are likely to correspond loosely with the caloric load of their lunch foods. This would also explain the individual variability in post-lunch hunger/satiety ratings.

Study 3

The results of Study 1 and Study 2 indicated that children were able to use the Teddy picture rating scale to reflect large changes in hunger/satiety in the context of imagined and real eating episodes. Nevertheless, one major limitation of Study 2 was the absence of information regarding children's lunch foods. We were unable to establish how much and what types of food children ate during their lunch break. This caveat meant that we were unable to establish whether our scale is sensitive to changes in hunger in satiety. We aimed to address this limitation in Study 3, by providing children with an ad libitum snack of known composition and quantity. We hypothesized that pre-snack hunger/satiety ratings would be associated with snack ingestion as hungrier children would consume larger amounts of the ad libitum snack. Additionally, we anticipated that snack food intake would be related to a change in rated hunger/satiety in that children who consumed greater amounts of the snack foods would show a greater decrease in hunger compared to children who consumed less of the snack foods.

Method

Participants

Thirty-six typically developing children aged 6 to 9 years participated in this laboratory based study. The sample consisted of 19 females and 17 males, who were predominantly White British. The sample consisted of predominantly middle class participants as indicated by parental education level (61.1% of parents had been educated up to a first degree level).

Measures

The previously described Teddy picture rating scale was used (see Method section Study 1, Figure 1). Additionally child age and gender as well as parental education were provided by parents.

Procedure

Children and their parents were invited to the Babylab at the University of Birmingham, UK. The study was conducted between April 2012 and July 2013. Participating children and their parents visited the Babylab between 10:00 and 15:00. Parents were told that their children should arrive in a non-fasted state, having consumed all meals and snacks as they usually would prior to attending the Babylab. Children participated individually. Initially the researcher introduced the child to the scale by looking at the pictures and reading the labels accompanying each picture with the child. The child was made aware of the differences between each picture and label. The child was then asked to indicate his/her own hunger using the scale. After this initial hunger/satiety rating the child received a standardised snack consisting of 250g of green grapes, 200g of carrot sticks, 200g of chewy sweets, 150g of chocolate chip cookies, 70g of ready salted crisps and 80g of salted pretzels. The child was informed that s/he would be left alone with the snack foods for 10 minutes while the researcher had to do some work in her office. The child was told that s/he could eat as much or as little of the snack foods as s/he liked. The child was monitored from an adjacent room over the 10-minute snack-period. The child made a second hunger/satiety rating two minutes after the end of the snack-period (see Appendix B for script). All snack foods were weighed prior to and immediately after the snack-

period. Parents provided written consent prior to their child's participation. This study was approved by the Ethical Review Committee of the University of Birmingham.

Statistical Analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05. Bar graphs were inspected and indicated that the data was not normally distributed. The calories that children consumed from each individual snack food were calculated and the overall intake of the snack food in calories was established. Children's ratings of hunger/satiety were examined. Spearman's correlations were carried out to examine whether child age was significantly related to children's ratings of hunger/satiety; additionally, Mann-Whitney U tests were carried out to assess the effect of gender on children's ratings. Wilcoxon Signed Rank tests were carried out to see whether children's ratings of their own hunger before and after an ad libitum snack differed and additionally Spearman's correlations were carried out to assess whether intake in calories was related to baseline hunger/satiety and hunger change.

Results

Children's ratings of hunger/satiety and ad libitum snack intake

Children's ratings of their own hunger before an ad libitum snack ranged from "Really hungry" (1) to "Really full" (5) (*Mdn* hunger rating=2, *IQR*=2), while their hunger/satiety ratings after an ad libitum snack ranged from "Really hungry" (1) to "Quite full" (4) (*Mdn* hunger rating=2.25, *IQR*=1). We calculated hunger/satiety change by subtracting post-snack hunger ratings from pre-snack hunger ratings. Hunger change scores ranged from -2 to +4 (average hunger change score *Mdn*=0.25 [*IQR*=1]). Examining hunger change scores in detail indicated that 3 children reported an increase in hunger following the snack, 15 children reported no change, while 18 children reported a decrease in hunger (see Figure 2 for more detail). The amount of calories children consumed of an ad libitum snack ranged from 79.35 kcal to 765.87 kcal (*Mdn*=268.95, *IQR*=236.14).

Figure 2 about here

Effects of age and gender on children's ratings of hunger/satiety and on ad libitum snack intake

Spearman's correlation analyses were carried out to examine whether child age significantly correlated with children's ratings of hunger/satiety and hunger change. Analyses indicated that age did not significantly correlate with children's ratings of their own hunger/satiety before an ad libitum snack $r_s(34)=-.004$, $p=.982$ or after an ad libitum snack $r_s(34)=.175$, $p=.307$. Child age was also not associated with hunger change $r_s(34)=.165$, $p=.335$ or with the intake of an ad libitum snack $r_s(34)=.125$, $p=.468$.

Mann-Whitney U tests were carried out to examine the effect of gender on hunger/satiety ratings and on ad libitum snack intake. The tests indicated that there were no differences in children's pre- or post-snack hunger/satiety ratings, their hunger change or their ad libitum snack intake based on gender (See Table 3). As there were no gender differences in children's ratings and their intake all further analyses were carried out for the sample as a whole.

Table 3 about here

Differences in hunger ratings before and after ad libitum snack intake and associations between hunger/satiety ratings and intake

A Wilcoxon Signed Rank test was carried out to examine whether there was a significant difference in children's ratings of their own hunger/satiety before and after an ad libitum snack. In line with our hypotheses, children rated themselves as significantly hungrier before consuming the snack ($Mdn=2$, $IQR=2$) than after consuming the snack ($Mdn=2.25$, $IQR=1$), ($Z=191.5$, $p=.007$).

Additionally, Spearman's correlations were carried out to assess whether hunger ratings and hunger change were associated with ad libitum snack intake. These analyses indicated that there was a significant negative correlation between pre-snack hunger/satiety rating and ad libitum snack intake

$r_s(34)=-.418$, $p=.006$, suggesting that those children who felt fuller before consuming an ad libitum snack ingested fewer calories than those children who felt hungrier before consuming the snack (see Figure 3). An inspection of Figure 3 suggested that the reported associations may be driven by a potential outlier; a child who arrived at the lab reporting feeling very full and who consumed few calories during the snack session. To assess whether the reported association was driven by this outlier the analysis was repeated removing the data from this child. The analyses indicated that the relationship between pre-snack hunger remained significant $r_s(33)=-.401$, $p=.017$. While caloric intake was not related with post snack hunger/satiety rating $r_s(34)=-.147$, $p=.197$ it was positively correlated with hunger change $r_s(34)=.301$, $p=.037$, indicating that children who ate more of the ad libitum snack indicated a greater decrease in hunger than those children who consumed less of the snack (see Figure 3).

Figure 3 about here

Discussion

Study 3 aimed to establish whether our new Teddy picture rating scale was able to reflect changes in hunger and satiety that were related to the intake of an ad libitum snack. The results of Study 3 are in line with findings from Study 1 and Study 2. The results of this final study give some indication that children may be able to use the scale to reflect changes in hunger and satiety in line with their intake. A replication of this final study and its findings in a larger sample, under controlled administration of test foods would be desirable and would allow firmer conclusions regarding the scale's ability to reflect changes in hunger and satiety in relation to intake. The results of the study do not just indicate that child intake is associated with pre-snack hunger ratings, but also suggest that changes in children's ratings of hunger and satiety are proportionate to their intake. Additionally, we found no age or gender effects in the final study, further supporting our previous

suggestions that individual age and gender effects observed in Study 1 and Study 2 are likely to be due to chance rather than to pervasive age or gender effects.

Overall Discussion

The majority of primary school children are able to self-report feelings of hunger/satiety using a new picture rating scale. In Study 1 and Study 2, which included large samples of children, around 90% of children were able to make correct judgements of hunger and satiety for Teddy. Similar levels of accuracy in estimated hunger and satiety ratings have previously been reported by Faith et al. (2002), who measured children's abilities to rate hunger and satiety with gender specific silhouettes. While Faith et al. did not assess children's ratings of hunger and satiety for real eating episodes, Study 2 and study 3 indicate that children, individually and in a group setting, are able to rate their own hunger and satiety in an eating context, using the new scale. Study 3 additionally shows that children's ratings of hunger/satiety are related to their intake of an ad libitum snack.

Study 2 and Study 3 also show that the majority of children were able to make ratings of hunger and satiety with very little training and instruction, which indicates that the scale could be used in studies in which the time for instruction and testing is limited. Our results indicate that children's ratings of hunger and satiety were largely unaffected by child gender and child age, suggesting that the scale can be used for samples of males and females aged 5-9 years.

It could be argued that children were simply mimicking the ratings they made for Teddy before and after the meal he ate, and that they were not using the scale to rate their own satiety perceptions. Nevertheless, it appears unlikely that children's ratings of their own hunger were significantly affected by their ratings of Teddy's hunger. In Study 1, children only rated their own hunger at one time point, but made two ratings of Teddy's hunger prior to that. In Study 2 children heard the story of Teddy only before lunch and made their own hunger ratings immediately after making ratings of Teddy. The final rating of Teddy's hunger that was made by children in Study 1 and Study 2, was rating Teddy as very full. Nevertheless, our results indicate that the vast majority of

children rated themselves as very hungry to hungry immediately after making this rating for Teddy, indicating that their own ratings were not influenced or primed by their previous rating of high fullness for Teddy. In Study 2 children did not hear the story about Teddy before making their second hunger/satiety rating after lunch. Instead they were simply asked to rate how hungry or full they were feeling at this moment. Here their ratings would not have been influenced by any immediately preceding rating of Teddy. In Study 3 children received instructions on how to use the scale, but did not hear the story about Teddy the Bear avoiding any risk of children mimicking a previous rating. Additionally, in all three studies specific emphasis was placed on children thinking about their “own hunger” and on how their tummies felt “right now”.

In study 3 the time span between the end of the 10 minute snack period and children’s subsequent ratings of hunger was very short and it is possible that the development of fullness perceptions may take longer to develop. Although we are reassured that this period was sufficient for an initial perception of fullness to develop, as overall children felt hungrier before the snack than after the snack the relationship between intake and fullness perception may have been stronger if there had been a greater delay between intake and fullness rating.

As previously suggested by Faith et al. (2002), children were able to reliably make choices about hunger and satiety that exceeded a binary choice option (hungry/full). Children’s ratings of pre- and post-meal and snack hunger were not limited to ratings of “really hungry” (1) and “really full” (5) but spanned across all five response categories.

Research with adults and children has indicated that visual analogue scales are more sensitive to subtle changes in bodily states than categorical rating scales like the Teddy Scale (Joyce, Zutshi, Hrubes, & Mason, 1975). One limitation of our scale is therefore its reduced ability to capture more subtle changes in hunger and satiety states changes (Flaherty, 1996; Keller et al., 2006). Nevertheless, categorical rating scales have been shown to be less affected by issues such as reliability when administered repeatedly to measure fluctuating states such as mood or hunger (Dovey, 2010; McCormack, Horne, & Sheather, 1988). Our own findings as well as findings by Faith et

al. (2002) indicate that children are able to make hunger and satiety estimates and ratings using categorical scales. Additionally, categorical scales seem to be easy to use, requiring little instruction compared to visual analogue scales (Keller et al. 2006).

Not all children who participated in our studies were able to make accurate ratings of estimated hunger and satiety in Teddy. It is possible that these children had not yet developed the cognitive skills and competencies necessary to use a categorical rating scale. It is important to note that those children who failed to make correct ratings did not differ in age or gender from those children who made accurate ratings. As only few children failed to use the scale correctly it may be appropriate to assume that these children did not pay adequate attention during the introduction of the scale or that they did not follow the story due to being distracted or bored. Finally, it may also be feasible that these children would have benefitted from further instruction or practice.

A further limitation to this study is that children were not asked to make partial satiety estimates of Teddy's hunger. Research has indicated that these ratings are much more difficult for children to make and that these ratings are also less reliable. One suggestion for future research and validations of the Teddy scale would therefore be to ask children to make ratings at various time-points during Teddy's meal and during a real meal.

The generalizability of our findings is limited as our sample consisted of predominantly White British children. Based on the Index of Multiple Deprivation calculated for the school and its surrounding areas and on parents' reports of their education level we can also assume that children had low to middle class family backgrounds. It is therefore essential to assess the applicability of our scale to more ethnically and socioeconomically diverse samples in future studies.

Conclusions

Overall, our results indicate that the newly developed hunger and satiety rating scale "Teddy the Bear" can be used by the majority of primary school children to make ratings of hunger and satiety regarding estimated and real eating episodes. The scale's ability to capture associated changes in

hunger and satiety needs to be further investigated. The scale may be useful for researchers aiming to establish hunger and satiety states and changes in children. Furthermore, the scale may be useful for interventions focusing on improving children's awareness of hunger and satiety in order to foster healthier eating behaviour as well as teaching children at risk for overweight/obesity about the appropriate timing of the initiation and termination of eating episodes.

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References

- Dovey, T. (2010). *Eating Behaviour*. Berkshire, England: Open University Press.
- Faith, M. S., Kermanshah, M., & Kissileff, H. R. (2002). Development and preliminary validation of a silhouette satiety scale for children. *Physiology & Behaviour*, 76, 2, 173-178.
- Flaherty, S. A. (1996). Pain measurement tools for clinical practice and research. *Journal of the American Association of Nurse Anesthetists*, 64, 2, 133-140.
- Hoffman, L. W. (1972). Early Childhood experiences and women's achievement motives. *Journal of Social Issues*. 28, 2, 129-155.
- Index of Multiple Deprivation (2012). Retrieved May 9, 2013, from <http://opendatacommunities.org/deprivation/map>
- Joyce, C. R. B., Zutshi, D.W., Hrubes, V., & Mason, R.M. (1975). Comparison of fixed interval and visual analogue scales for rating chronic pain. *European Journal of Clinical Pharmacology*, 8, 6, 415-420.
- Keller, K. L., Assur, S. A., Torres, M., Lofink, H. E., Thornton, J. C., Faith, M. S. et al. (2006). Potential of an analog scaling device for measuring fullness in children: Development and preliminary testing. *Appetite*, 47, 2, 233-243.
- Kissileff, H. R., Keller, K. L., Lofink, H. L., Torres, M., & Thornton, J. C. (2008). Rating of fullness after ad libitum meals are not predicted from ratings of fullness during interrupted meals in pre-school children [Abstract]. *Appetite*, 51, 2, 376.
- McCormack, H. M., Horne, D. J., & Sheather, S. (1988). Clinical applications of visual analogue scales: A critical review. *Psychological Medicine*, 18, 4, 1007-1019.
- Shields, B. J., Palermo, T. M., Powers, J. D., Grewe, S. D., & Smith, G. A. (2003). Predictors of a child's ability to use a visual analogue scale. *Child: Care, Health & Development*, 29, 4, 281-290.
- Shields, B. J., Cohen, D. M., Harbeck-Weber, C., Powers, J. D., Smith, G. A. (2003). Pediatric pain measurement using a visual analogue scale: A comparison of two teaching methods. *Clinical Pediatrics*, 42, 3, 227-234.

Appendix A

Last Sunday, Teddy went to the park to watch the birds and squirrels play in the sun. Teddy spent all morning walking around the park and sitting underneath the trees watching the birds and squirrels play. As time went by Teddy started to feel very hungry, it had been a long time since he had eaten his breakfast. Teddy's belly was rumbling and he couldn't wait to get back home to have his lunch. He started to walk home thinking of all the food he would love to eat (Child rating). After Teddy got home he started to make his lunch. He got out bread, cheese and salad, crisps, cookies and chocolate and poured himself a large glass of juice/milk. He then started to slice little tomatoes, cucumber, and some onion to put on his sandwich. He then buttered the bread, sliced the cheese and put it all together. It was a huge sandwich. Teddy started to eat the sandwich; he also ate a whole bag of crisps, and drank some of his juice/milk. After finishing the sandwich and crisps Teddy also ate loads of biscuits and chocolate and drank the rest of the juice/milk. His belly was so full Teddy could barely move. He was definitely not hungry anymore (Child Rating).

Appendix B

Script for children's own hunger ratings Study 1:

"Now that you've heard about the story of Teddy the Bear I was wondering if you could tell me about how hungry you are feeling right now. If you think about your own tummy and how empty or full it is right now, which Teddy would you say shows me how hungry or how full you are feeling. There is no right or wrong answer; this is just about how you feel." (Brief pause followed by restating all the scale points).

Script for children's own hunger ratings Study 2:

Before lunch/First rating - "Now that you've heard about the story of Teddy the Bear I was wondering if you could tell me about how hungry you are feeling right now. If you think about your own tummy and how empty or full it is right now, which Teddy would you say shows me how hungry or how full you are feeling. There is no right or wrong answer; this is just about how you feel." (Brief pause followed by restating all the scale points).

After lunch – If you think about your own tummy and how empty or full it is right now, which Teddy would you say shows me how hungry or how full you are feeling. There is no right or wrong answer; this is just about how you feel." (Brief pause followed by restating all the scale points).

Script for children's own hunger ratings Study 3:

Before snack - "I was wondering if you could tell me about how hungry you are feeling right now. If you think about your own tummy and how empty or full it is right now, which Teddy would you say shows me how hungry or how full you are feeling. There is no right or wrong answer; this is just about how you feel." (Brief pause followed by restating all the scale points).

After lunch – If you think about your own tummy and how empty or full it is right now, which Teddy would you say shows me how hungry or how full you are feeling. There is no right or wrong answer; this is just about how you feel." (Brief pause followed by restating all the scale points).

Table 1

Differences in Hunger/Satiety ratings between Males (N=20) and Females (N=27)

Variable	Males	Females	Test statistics	Significance
Teddy's hunger pre-meal	<i>Mdn</i> =1 (<i>IQR</i> =0)	<i>Mdn</i> =1 (<i>IQR</i> =1)	<i>U</i> =195.5, <i>z</i> =-2.07	<i>p</i> =.039; <i>F</i> > <i>M</i>
Teddy's hunger post-meal	<i>Mdn</i> =5 (<i>IQR</i> =0)	<i>Mdn</i> =5 (<i>IQR</i> =0)	<i>U</i> =240, <i>z</i> =-.71	<i>p</i> =.478
Child's current hunger ¹	<i>M</i> =2.2 (<i>SD</i> =1.4)	<i>M</i> =2.65 (<i>SD</i> =1.13)	<i>t</i> =1.22	<i>p</i> =.23

¹The variable "Child's current hunger" was normally distributed. Mean and SD are therefore provided and an independent samples *t*-test was carried out.

Table 2

Differences in Hunger/Satiety ratings between Males (N=28) and Females (N=23)

Variable	Males	Females	Test statistics	Significance
Teddy's hunger pre-meal	<i>Mdn</i> =1 (<i>IQR</i> =0)	<i>Mdn</i> =1 (=0)	<i>U</i> =316.5, <i>z</i> =-.145	<i>p</i> =.885
Teddy's hunger post-meal	<i>Mdn</i> =5 (<i>IQR</i> =0.75)	<i>Mdn</i> =5 (<i>IQR</i> =1)	<i>U</i> =360.5, <i>z</i> =.917	<i>p</i> =.359
Child's hunger pre-lunch	<i>Mdn</i> =1 (<i>IQR</i> =2)	<i>Mdn</i> =1 (<i>IQR</i> =2)	<i>U</i> =337.5, <i>z</i> =.326	<i>p</i> =.744
Child's hunger post-lunch	<i>Mdn</i> =3.5 (<i>IQR</i> =2)	<i>Mdn</i> =4 (<i>IQR</i> =2)	<i>U</i> =286.5, <i>z</i> =-.706	<i>p</i> =.48

Table 3

Differences in Hunger/Satiety ratings and ad libitum snack intake between Males (N=17) and Females (N=19)

Variable	Males	Females	Test statistics	Significance
Child's hunger prior to ad libitum snack	<i>Mdn</i> =1.5 (<i>IQR</i> =1.5)	<i>Mdn</i> =2 (<i>IQR</i> =1)	<i>U</i> =103.5, <i>z</i> =-1.93	<i>p</i> =.066
Child's hunger after ad libitum snack	<i>Mdn</i> =2 (<i>IQR</i> =1)	<i>Mdn</i> =2.5 (<i>IQR</i> =1)	<i>U</i> =141, <i>z</i> =-.681	<i>p</i> =.531
Hunger change (post snack-pre-snack)	<i>Mdn</i> =0.5 (<i>IQR</i> =1)	<i>Mdn</i> =0 (<i>IQR</i> =1)	<i>U</i> =191.5, <i>z</i> =.996	<i>p</i> =.346
Ad libitum snack intake (calories)	<i>Mdn</i> =259.95 (<i>IQR</i> =345.96)	<i>Mdn</i> =277.946 (<i>IQR</i> =204.86)	<i>U</i> =186, <i>z</i> =.776	<i>p</i> =.452

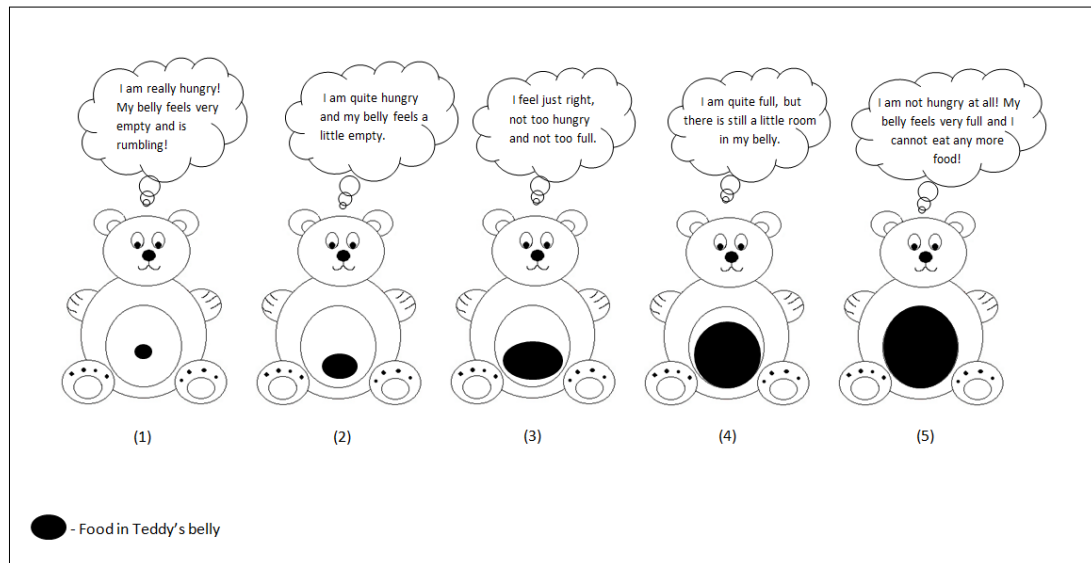


Figure 1. Hunger and Satiety Rating Scale: Teddy the Bear

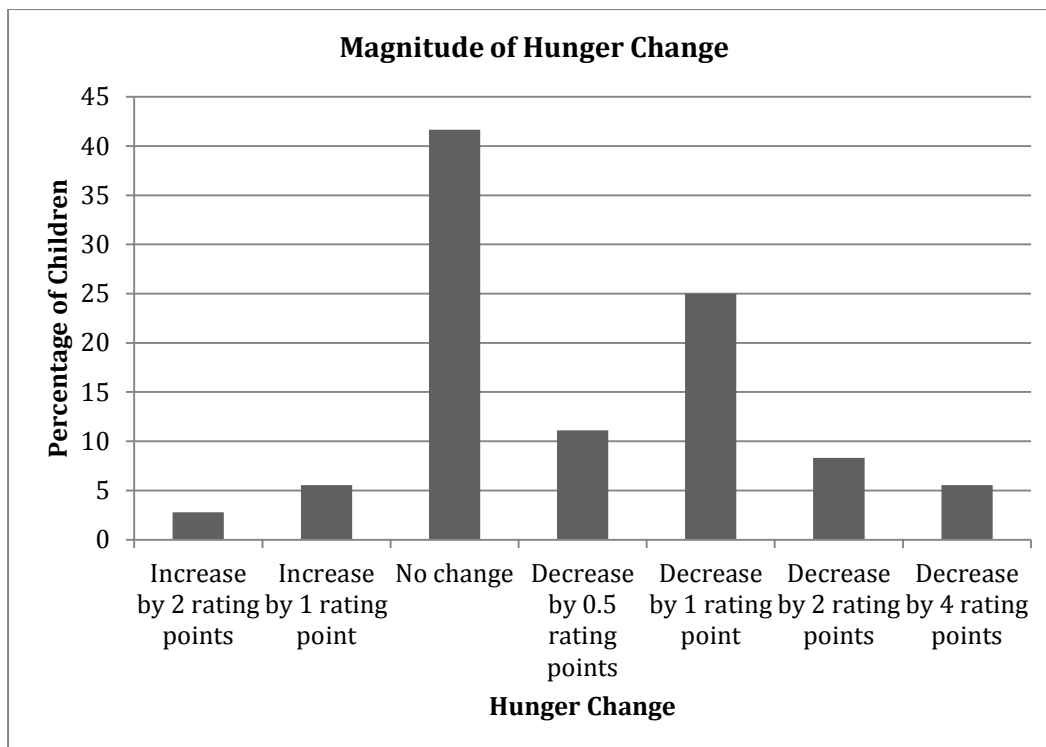


Figure 2. Percentage of children whose hunger remained the same, increased or decreased after consuming a snack and magnitude of the associated change in hunger

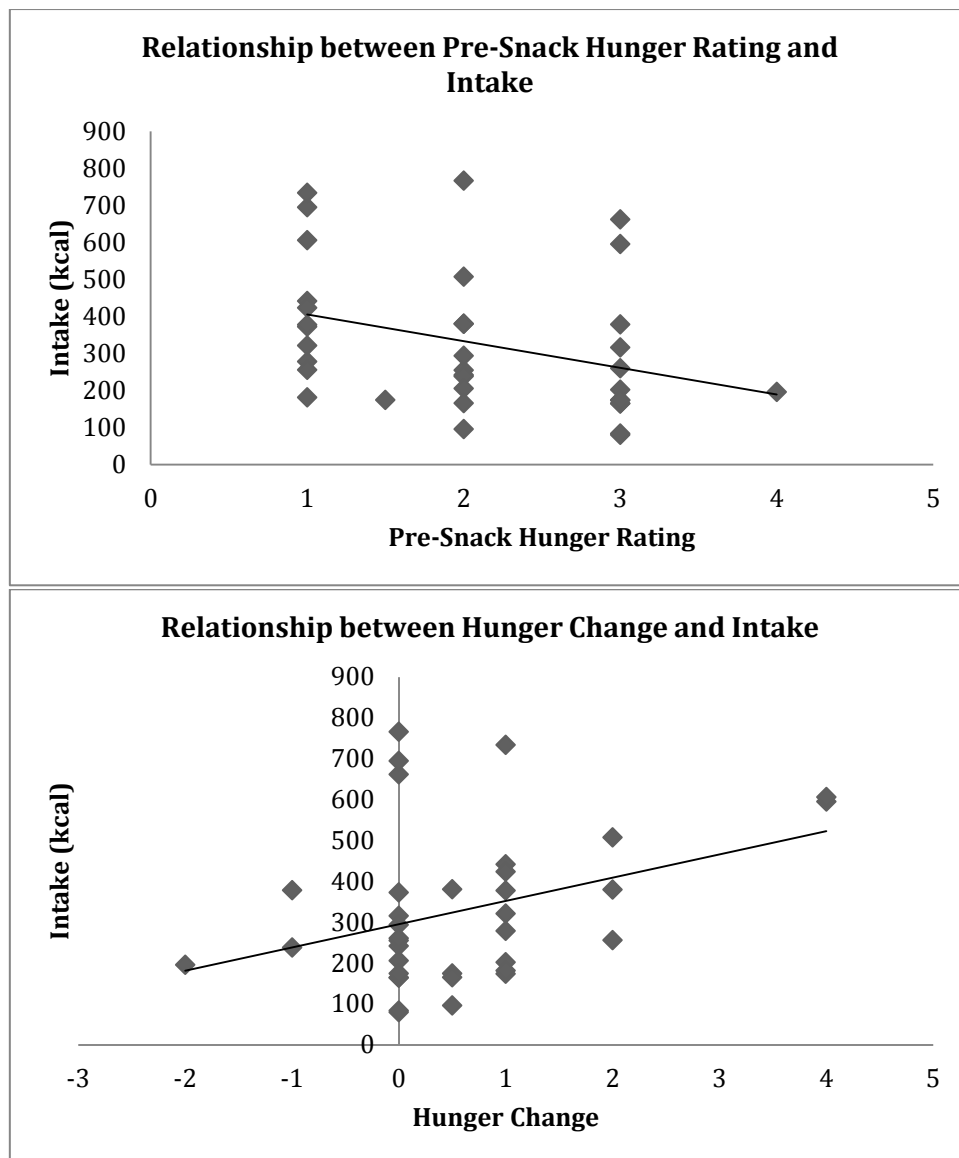


Figure 3. Plots of the relationships between pre-snack hunger rating and subsequent ad libitum snack intake and hunger change rating and ad libitum snack intake